PALEOPROTEROZOIC HIGH ^{13}C DOLOMITES FROM THE LASTOURSVILLE AND FRANCEVILLE BASINS (SE GABON) STRATIGRAPHIC AND SYNSEDIMENTARY SUBISDENCE IMPLICATIONS

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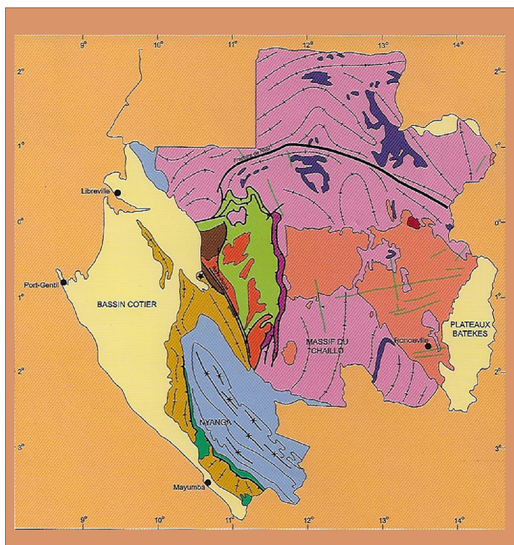
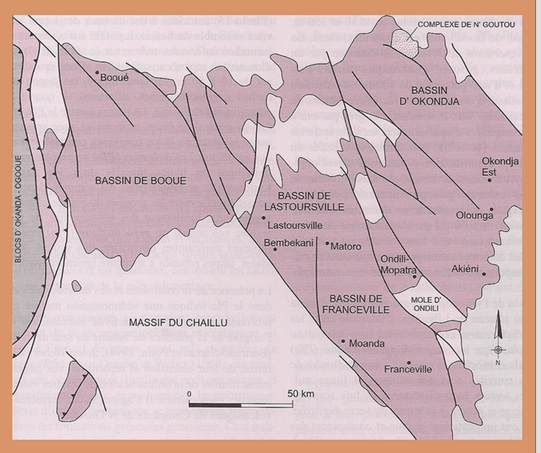
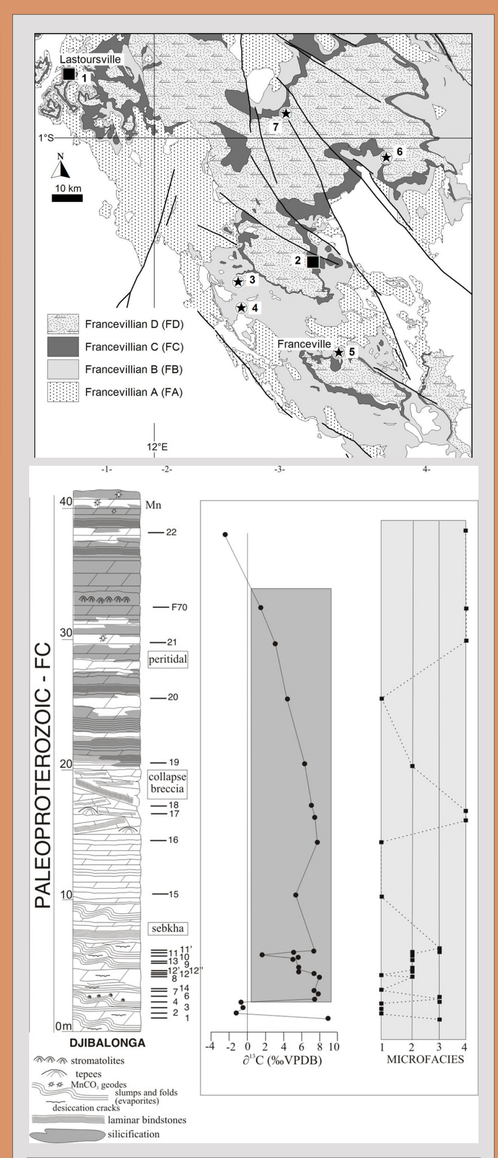
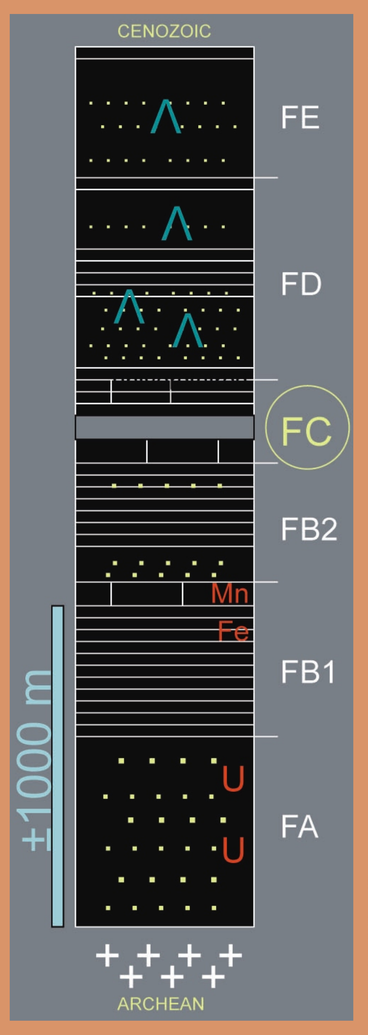
With the discovery in the 1970s of two-billion year old nuclear reactors in Oklo, Gabon, the Paleoproterozoic of the Franceville basin (Gabon), neglected for many years, attracted the attention of the international community. This led to the intensive study of the basin for about ten years. Between 2006 and the present time, our studies have focused on the interaction between the Paleoproterozoic sedimentary filling (Francevillian) and tectonics. We participated in a large mapping project sponsored by the European Union (SYSMIN funds). Here we have reviewed the lithostratigraphy of the Francevillian and carbonate rocks of this series for a sedimentological and stable isotope study. Although the Francevillian series has been known for a long time the difficulty of access the region prevented such a scientific study. Our analysis establishes the palaeoenvironments of deposition with the first report of a sebkha series in the Francevillian, and also reveals a large positive excursion of carbon-13 in the carbonates. This excursion is known on a worldwide scale in the 2.22-2.06 Ga time interval and is reported here for the first time in Gabon. The detailed analysis of this excursion coupled with the lithostratigraphy has considerable consequence on the regional stratigraphy and on the functioning of the basins or sub-basins which were drived by differential subsidence regimes. The inferred time interval of the excursion is in good agreement with the ages we obtained from new radiometric dating of the series.

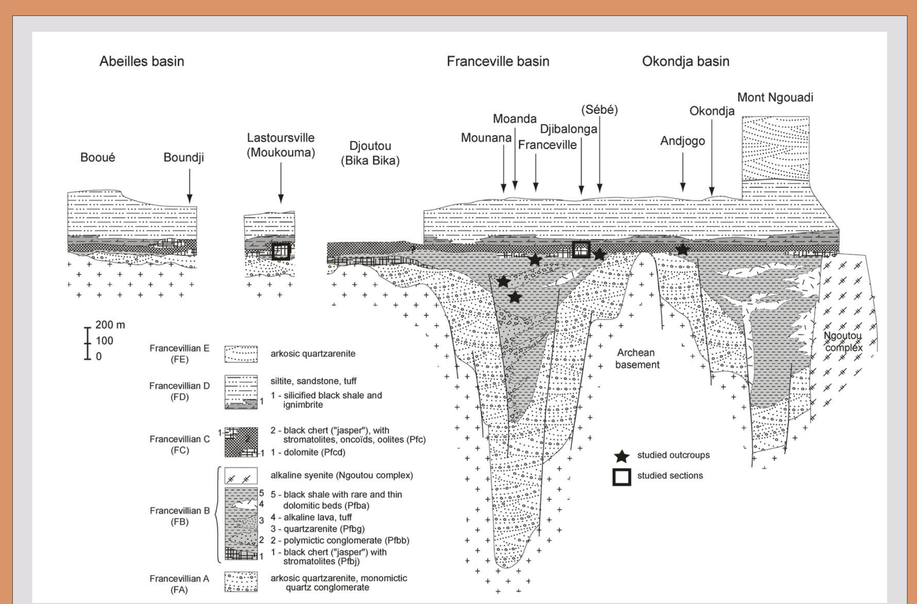


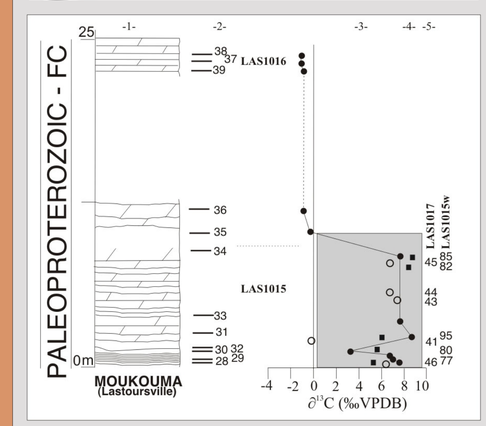


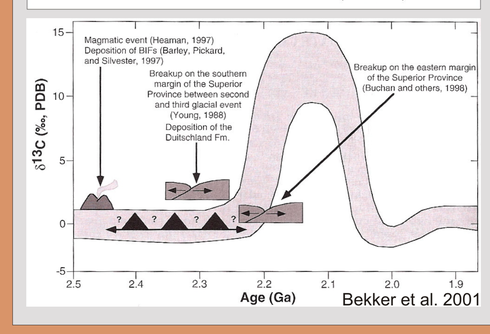




The Proterozoic Franceville Basin is a large, first-order foreland basin made up of several sub-basins known as, from west to east, the Booué (or les Abeilles), Lastoursville, Franceville and Okondja basins separated by the Ondili and Amieni basement horsts (Wéber, 1969; Gauthier-Lafaye, 1986; Chevallier et al., 2002). Located at SE Gabon this basin lies within the Congo Craton at between 1°-2°S and 13°-13°44' and cover an area of 35,000 km^2. The underlying Archean basement is composed of plutonic rocks, mainly Neo-archean granites (2500 to 2800 Ma), with enclaves of metamorphic rocks (gneisses, micaschists, ferruginous metaquartzites). The Franceville Basin is well known for its vast deposits of uranium and manganese, and for the discovery at Oklo of the Paleoproterozoic fossil nuclear-fission reactors (1.8 Ga, Neuilly et al., 1972; Gauthier-Lafaye and Wéber, 1989; 1.8-2.0 Ga, Gauthier-Lafaye et al., 1989; 2.0 Ga, Ruffenach et al., 1976; 2.05 Gancarz, 1978 in Draganic et al., 1983). The term 'Série Francevillienne' was defined in 1920 for the volcano-sedimentary rocks of the basin and the first 1:500 000 scale reconnaissance map was published 30 years later (Baud, 1954). The western part of the Abeilles basin is known through a systematic mapping that has been carried out on the two square degrees of Booué and Mouila by the BRGM (Prian et al., 1990, 1991). Recently a project sponsored by the European Union (SYSMIN funds) has permitted a new mapping of square degrees of Franceville and Okondja (Bouton et al., 2009). First results from this study are reported in Thiéblemont et al. (2010). One of the most important features of the Franceville foreland basin is its lack of pervasive metamorphism and its generally undeformed to weakly deformed nature.







Five stratigraphic units have been recognized, namely FA, FB, FC, FD and FE formations (Wéber, 1969) constituting the Francevillian Group; for more details, see Thiéblemont et al. 2010). The tectonic evolution of the basin shows two main sedimentological transitions separated by major unconformities. The first phase corresponds to the transition from a fluviodeltaic sedimentation at the base (FA) to a marine sedimentation (FB-FC). The second phase resulted from the propagation of north-south faults that formed a number of grabens into which fine detrital sediments of FD and FE (flysch-type sensu Chevallier et al., 2002; fluvial or deltaic systems according to Thiéblemont et al., 2010) were deposited. New radiometric dating based on zircon populations from a tuffaceous sandstone of the FD Formation yielded an age of 2072 ± 29 Ma. The youngest age of the Francevillan Group is 2021 ± 18 Ma obtained in the FE Formation (Bouton et al., 2009). These ages are in the range of those of previous authors (Bros et al., 1992) and imply that the FA, FB, FC and FD formations are in the time range of the worldwide ^{13}C enrichment (Karhu and Holland, 1996; Bekker et al., 2001).

The studied paleoproterozoic series is composed of laminar dolomitic muds that have been colonized by flat cyanobacterial mats. Interstitial sulphate (gypsum, anhydrite, polyhalite?) formed displacively in low supratidal and intertidal environments. Occasional marine flooding of this low-lying sebkha allowed the formation of the evaporite minerals similarly to what is observed today in the Abu Dhabi sebkha (McKenzie et al., 1980).The overlap of the four microfacies on the field, and most of them on thin sections, indicates a diagenetic continuum from restricted shallow (microfacies 1) to very shallow and more evaporitive settings (microfacies 2-4) with a progressive digestion of the primary mud. This succession recorded diagenetic salinity cycles in a sebkha. As no indication for higher energy events (oolites, true intraclasts, storm layers…) has been observed in this carbonate partof the FC succession of Lastoursville and Djibalonga sections, carbonate mud formed in situ in a low-energy, restricted sublittoral environment. No clear evidence of subaerial exposure was found. The energy index was probably higher in the Booué and Okondja areas as suggested by the oolites, the oncolites and the domal stromatolites (Prian et al., 1990; Bouton et al., 2009b).